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THE STATE of ALASKA
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PO Box 2256
Wichita, KS 67201

Loren Garner
Flint Hills North Pole Refinery
1150 H&H Lane
North Pole, AK 99705

Re: Alternatives to evaluate during Feasibility Study

Dear Mr. Smith and Mr. Garner:

As a follow up to the technical meeting held on October 23, 2013, the Alaska Department of Environmental Conservation (DEC) expects Flint Hill Resources Alaska (FHRA) to evaluate remedial alternatives that range from the no action alternative to alternatives that maximize treatment to achieve cleanup in the shortest possible timeframe. To assist with this effort cooperatively, DEC is providing the attached list of example remedial alternatives to be used by FHRA in developing remedial alternatives in the Feasibility Study (FS) document. Please do not view this list as complete or prescriptive by any means. DEC is providing this list as a prototype and does not anticipate that your list of alternatives will be limited by this sample; its intent is to provide an example of the array of alternatives which DEC expects to be put forth and evaluated in an FS. As we have discussed, communication between DEC and FHRA during this process is very important in order to obtain input and agreement on the technologies, processes, and alternatives considered for implementation at the site.

As you are aware, CERCLA (Comprehensive Environmental Response, Compensation and Liability Act) provides clear guidance for developing alternatives considered for remediation in the FS. Due to EPA oversight on this project, it is appropriate for the upcoming FS documents to follow CERCLA guidance. Site-specific alternatives that represent the maximum extent to which permanent solutions and treatment technologies can be practicably utilized in a cost-effective manner are to be included in the FS. As we discussed at our meeting, a "no action" alternative must be included and considered. This alternative requires no action at the site, and is provided for purposes of comparison with the other alternatives. In addition to the CERCLA requirements, DEC requests that, at a minimum, alternatives that present varying degrees of active onsite remediation, off-site hotspot treatment, and a combination of both (listed in the enclosed document

as Alternatives F, G, and H) be included. Please note that the analysis of each alternative must be completed with sufficient detail to allow understanding of the uncertainties as well as the anticipated performance of each remedy.

A series of definitions are provided in the enclosed document, including a definition for a source zone and a hotspot. Source zones are defined as the subsurface zones containing a contaminant reservoir sustaining a plume in groundwater. At the North Pole Refinery, there are source zones for multiple contaminants of concern (i.e., sulfolane, petroleum). Hotspots are defined as areas of elevated dissolved contaminants of concern (i.e., sulfolane). As used in the enclosed document, the term hotspot refers to areas outside of the source zones and will generally be applied to areas where contamination has caused or could cause sustained degradation of the quality of the sole-source groundwater aquifer and where restoration will not likely occur within a reasonable amount of time if left untreated. The determination of the areas defined as source zones or hotspots, and what constitutes a "reasonable amount of time", will be developed through discussions within the technical team.

This process is anticipated to be iterative, taking into account the following factors:

- Projected impact of source zone and hotspot remediation on overall aquifer restoration;
  - Reduction in the extent and volume of groundwater exceeding cleanup goals;
  - Reduction in the requirements to provide alternate water supplies;
  - Timeframe to achieve full beneficial use of groundwater;
- Implementability of source zone and hotspot remediation;
- Cost/benefit of source zone and hotspot remediation; and
- Resultant reduction on contaminant migration potential.

DEC would like to develop concentration ranges and targeted areas for source zones and hotspots cooperatively with Flint Hills in order to maximize the treatment benefits as well as reduce the overall remediation timeframe. This topic will be included in the agenda for the upcoming technical meeting in January, after all the information resulting from the ongoing field season has been received.

If you have any questions or would like to discuss this further please contact me at 907-451-2192 or at tamara.cardona@alaska.gov.

Sincerely,

T Cardona

Tamara Cardona, PhD
Project Manager

cc. Rick Albright, US EPA Region 10, Office of Environmental Cleanup Director
Kristin Ryan, Alaska Department of Environmental Conservation, Spill Prevention and Response Division Director
Steve Bainbridge, Alaska Department of Environmental Conservation, Contaminated Sites Program Manager

Example Remedial Alternatives List for the Flint Hills Refinery, North Pole, Alaska

Alaska Department of Environmental Conservation Project Team

November 12, 2013

Purpose:

To outline a list of potentially applicable remedial alternatives that optimize the combined use of source control, source reduction, dissolved plume containment, and dissolved plume treatment technologies to reduce contaminant concentration, mass, volume, mobility, toxicity, and timeframe to reach the cleanup goals, as per the August 16, 2013 ADEC Remedial Action Objectives communication.

Approach:

For the purposes of this paper, example remedial alternatives will cover the full extent of the plume from sources to distal boundaries of the dissolved contaminant plume. Administrative subdivisions (e.g. on-site and off-site) can be overlain once the direct dependencies of upgradient remedial actions on downgradient remedial actions are established. In an effort to be concise, remedial alternatives recommended for further detailed analysis will be described using example configurations and component technologies. In many instances, different component technologies (e.g. source zone treatment, plume interception, etc.) can be applied interchangeably to optimize remedial performance. In the examples below, the combined use of source zone reduction, plume interception/containment, and/or plume treatment is the point of emphasis rather than a presentation of exact treatment locations or remedial design specifications. **It is assumed that continued LNAPL free product recovery, long-term monitoring, remedial performance review and optimization, and institutional controls will be required for all alternatives,** with the exception of the "No Action" alternative.

Definitions and assumptions

- It is assumed that primary sources have been abated, therefore this document addresses secondary sources. A secondary source is defined as a significant accumulation of the contaminant mass resulting in the exceedance of groundwater cleanup goals. It is known that secondary sources exist and it is assumed that these secondary sources are mass transfer limited with complete dissolution of mass into groundwater occurring over numerous decades.
- Contaminants of Concern (COCs) - in this document include petroleum hydrocarbons, sulfolane, perfluorinated compounds, and potential intermediate products of the degradation of sulfolane. It is assumed that sulfolane is amenable to treatment via aerobic biodegradation.
- Source Zone – A subsurface zone containing a contaminant reservoir sustaining a plume in groundwater. This term will generally be applied to onsite areas where COC

treatment will promote restoration of the aquifer within an acceptable timeframe. These areas can be selected upon further discussions among the technical team.

- Hotspots – Hotspots are defined as areas of elevated dissolved COC concentrations. This term will generally be applied to areas where contamination has degraded the quality of the sole-source groundwater aquifer, and restoration can occur within a reasonable amount of time. The determination of the areas defined as hotspots and what constitutes a "reasonable amount of time" will be developed through discussions within the technical team. This is anticipated to be an iterative process, taking into account the following factors:

    - Projected impact of source zone and hotspot remediation on overall aquifer restoration timeframe;
    - Implementability of source zone and hotspot remediation;
    - Cost/benefit of source zone and hotspot remediation; and
    - Resultant reduction on contaminant migration potential.

  Note: Hotspots can represent portions of a continuous plume core where the upgradient and/or downgradient are not currently delineated. Thus, hotspot treatment can be initiated before the entire plume core or area of elevated concentrations is defined.

- Light Nonaqueous Phase Liquid (LNAPL) or Free Product Recovery – It is a regulatory requirement to recover LNAPL to the "maximum extent practicable". It is assumed that LNAPL recovery will proceed until regulatory requirements are met. LNAPL exists as a free phase in soils and will be viewed as a soil source area.

- Remedial Action Objectives (RAOs) –remediation criteria used in feasibility study, performance monitoring, and regulatory compliance. The remedial alternatives in this document are based on achievement of RAOs provided in the August 16, 2013 ADEC Remedial Action Objectives communication from ADEC to FHR. The August 16, 2013 letter establishes media-specific RAOs and states ADEC's expectations that the final cleanup plan is expected to use active remediation of contaminant sources, to the maximum extent practicable, to reduce overall contaminant mass, volume, mobility, and toxicity and aims to reach the established RAOs. Progress towards meeting the RAOs must be measurable, and the acceptable/reasonable remedial timeframe should be developed during the feasibility study.

- Alternate Water Supply - Point of Entry (POE) treatment or alternative water supply (i.e., bulk tank or city water). For this document's purposes a point of entry treatment reduces COCs in drinking water to acceptable levels. It is assumed that POE treatment and/or alternate water supply will be necessary in addition to subsurface remediation efforts.

- Institutional Controls - Controls established by ADEC to ensure compliance with cleanup levels; protection of human health, safety or welfare, or the environment; and the integrity of cleanup activities. Examples of institutional controls include restrictive covenants, deed restrictions, easements, zoning restrictions, physical or engineering measures that limit exposure to the contaminants, etc.

Example Source Zone Treatment, Plume interception, Hotspot Treatment, Hydraulic Control Technologies

The following table provides examples of technologies potentially effective for source treatment, plume interception, "hotspot" treatment, and hydraulic control applications.

Technology	Application	Primary Target COCs	Target Media	Notes
Excavation	Source reduction	Petroleum Sulfolane	Soil	Shallow soils. Lagoon B example
Bioventing	Source reduction	Petroleum Sulfolane	Soil, Unsaturated	Untested for sulfolane
Soil vapor extraction	Source reduction, soil gas abatement	Volatile petroleum, biogenic methane	Soil, Unsaturated	Also stimulates aerobic biodegradation
Ground water extraction with above ground treatment	Hydraulic containment, plume interception	Sulfolane	Ground water	Above ground treatment via aeration, GAC, and/or aerobic bioreactor; Could include oxygenated water reinjection
Ground water extraction and treatment in gravel pit ponds or aeration ponds	Hydraulic containment, plume interception	Sulfolane	Ground water	Could include oxygenated water recirculation; Could be implemented as a remedial action or as an adjusted pit operation approach
Air sparging (Shallow <25 ft bgs)	Plume interception	Sulfolane	Ground water, residuals in soil matrix	Prior pilot test results favorable from dense injection grid,
Air sparging (Deep > 25 ft bgs)	Plume interception	Sulfolane	Ground water, residuals in soil matrix	Site-specific pilot testing required,

Technology	Application	Primary Target COCs	Target Media	Notes
Oxygenated ground water recirculation wells	Plume interception	Sulfolane	Ground water	Multiple configurations possible (e.g. in-well airlift or mechanical pumps)
Use of on-site contaminated ground water as refinery process water	Hydraulic control, source reduction	Sulfolane	Ground water	Focused extraction of shallow ground water where sulfolane is elevated (e.g. >10 mg/L); May include oxygenated water reinjection
Oxygen-releasing materials	Source reduction, source zone treatment	Sulfolane	Ground water	Injection of commercially available solid or liquid (e.g. H_2O_2) oxygen amendments; production of potential sulfolane intermediates must be understood

Notes: GAC = Granular activated carbon; ft bgs = feet below ground surface;

For all alternatives, the production of potentially toxic sulfolane intermediates either under natural or enhanced conditions should be considered .

Example Remedial Alternatives

The examples listed below represent a range of technologies from no action to the maximum action practicable to illustrate the potential additive effects of different actions on remedy effectiveness, cost, and lifetime.

Note: All alternatives, with the exception of Alternative A, assume alternative water supplies or continued operation and maintenance of POE systems for existing and new users of ground water within the sulfolane plume area; continued LNAPL recovery to the maximum extent practicable; and institutional controls. The technologies in the examples can be used interchangeably and in combination with other technologies in the table above.

- Alternative A - No action
- Alternative B – Plume-wide alternate water system (i.e., existing POE systems or public water supply)
- Alternative C - Existing GW pump & treat system
- Alternative D - Existing GW pump & treat system with single off-site shallow plume interception at a hotspot location

- Alternative E - Existing GW pump & treat system with multiple plume interception transects across hotspot areas between VPT and MW-161 and hotspot treatment near Private Well 1230
- Alternative F - Existing GW pump & treat system and on-site source zone treatment
- Alternative G - Existing GW pump & treat system with off-site shallow plume interception in hotspot areas and on-site source zone treatment
- Alternative H - Existing GW pump & treat system with multiple plume interception transects across hotspot areas between VPT and MW-161 and hotspot treatment near Private Well 1230 (i.e. 500-600 ug/L sulfolane at 231 ft bgs) and on-site source zone treatment

The final list of alternatives will be dependent on FHR's evaluation of the data but must include at a minimum a no action alternative, alternatives that include active onsite source zone treatment, alternatives that include off-site shallow plume interception in hotspot areas with on-site source zone treatment, and an alternative that utilizes treatment technologies to the maximum extent practicable.

Overall

The analysis of the above alternatives should:

- Provide information to answer: to what extent does more aggressive source zone or hotspot treatment reduce the lifetime and strength of the plume and therefore the requirement to operate POE or hydraulic containment systems?
- Provide information to answer: are the alternatives preventing off-site plume expansion, and what is the reduction expectation for the dissolved contaminant plume over a period of 5, 10, and 15 years?
- Ensure that each alternative (except no action) satisfies threshold criteria:
  - Overall protection of human health
  - Compliance with applicable or relevant and appropriate requirements (ARARs)
- Be based on the following criteria:
  - Long term effectiveness and permanence
  - Reduction of toxicity, mobility, or volume through treatment
  - Short term effectiveness
  - Implementability
  - Cost